Draft Report on Turnkey Osiris Particle Results at the Market and Southampton Hotel Sites in Jersey for 2006

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Contents

1.0 Executive Summary:

Health Protection has monitored Air Quality in Jersey since 1994. This monitoring involves Nitrogen Dioxide (NO_2), Volatile Organic Compounds such as Benzene and Toluene (VOCs) and prior to 2002 Sulphur Dioxide (SO_2) via diffusion tubes. The reports from 1998 to 2005 for these surveys can be found at www.gov.je. In 1999 and 2002 two Turnkey Osiris particle measurement units were purchased which allowed real time particles measurement (PM_{10}). This type of measurement ie laser particle measurement has not been certified as 'equivalent' method as detailed in the Local Air Quality Management Technical Guidance LAQM.TG(03) [9] a and therefore the data produced allows for screening rather than a detailed assessment. In May 2006 a real time NOx/NO2 chemiluminescent analyser was also purchased and is sited at the central market site.

The Osiris units were sited at:

1. The central Market on Halkett Place at approx 12 feet high above pavement level (ref: Unit No 2209). This unit was sent to Turnkey in June 2006 for calibration and was found to be defective. Due to the costs involved it has yet to be replaced or repaired.

2. La Route es Nouaux, Bellozanne Valley, (ref: unit 2113) to measure traffic emissions from vehicles using the valley eg driving to and from the incinerator, Jersey Coal, the Co-op warehouse. It was situated 20 feet from the road at ground level behind the Department of Traffic and Transport Service's workshop (ref:2113)

3. Short term tobacco smoking monitoring survey: the unit 2113 was used during 2006 for a number of short term surveys were carried out tasks eg Tobacco smoking monitoring survey, and to determine occupational particle levels within the cremator area within the crematorium.

4. Havre Des Pas St Helier: the unit 2113 was moved in September 2006 to measure particle levels associated with traffic driving to La Collette via Havre Des Pas to provide an indication of base levels of PM_{10} for screening purposes. This information was designed to assist Traffic and Transport Services in providing data for the Health Impact Assessment in relation to the proposed Energy from Waste plant (efw)

Particles include dust and smoke and have a well documented respiratory effect on human health and significant sources of PM_{10} in the UK are road transport (25%), quarrying (14%), power stations (14%) and other industrial combustion (10%). In Jersey, the main source is road transport with high levels monitored mainly at road junctions and along canyon streets.

Results for 2006 for a 6 month period at the Market site exceeded the EC and UK Air Quality objectives by 3 times (8 corrected) and at Bellozanne valley site for a period of 2½ months 4 times (6 corrected) .Results for a 3½ month period at the Havre Des Pas site exceeded the EC and UK Air Quality objectives 7 times (24 corrected). These objectives (ie Stage 2) only allow 7 exceedances per calendar year and should be complied with by 2010 in the UK.

Note: In the recent UK Government consultation on the air quality strategy, it was noted that the European Commission is developing a new Air Quality Directive and that the Commission has recognised that continuing to pursue the indicative 2010 limit values for particles is unlikely to generate a cost effective improvement in air quality. Therefore, it seems unlikely that the 2010 objectives will ever be included in UK legislation.

The results give additional support to the importance of reviewing the Draft 2003 Air Quality Strategy. (a copy of this document can be downloaded at www.health.gov.je).

The States of Jersey has agreed to work toward the limits set out in the EU Daughter Directive 99/30/EC which sets legally binding limit values for Nitrogen Dioxide (NO_2) Particulates (PM_{10}), Sulphur Dioxide and Lead.

As the sampling sites have changed since 2004 only the Market and Bellozanne sites results can be compared. The annual mean levels have reduced from 2004, 8 exceedances to 3 (8 corrected) in 2006 at the market and remained the same at the Bellozanne site 4 in 2005 (8 corrected) and 4 in 2006 (6 corrected) however care is required in direct comparison as the sampling periods varied.

However the results when compared against the Air Pollution Bandings indicate that air quality was generally similar to 2005 ie at the Bellozanne site ie 2005: 3 days of moderate air pollution and 1 day of high air pollution and in 2006: 2 days of moderate air pollution and 1 day of high and 1 day of very high air pollution. The market had in 7 days and 3 days of moderate air pollution in 2005 and 2006 respectively.

At the market site levels of particles spike early morning and this can explained by the presence of delivery/refuse vehicles close to the measurement site resulting in high levels of air pollution. The market have been asked to remind all delivery companies to switch off engines as far as is practicable whilst parked.

Note: Care must be taken interpreting the results as the method of measurement is not an approved method as specified by the European Union and therefore the data provides a guide to whether the Health limits are being met or exceeded.

2.0 Particles: Sources and Health Effects

Particles in the atmosphere originate from a wide variety of sources. They take the form of dust; smoke of very small liquid or solid particles called aerosols. Particles may be either emitted directly into the atmosphere (ie primary particles) or formed subsequently by chemical reactions (ie secondary particles). PM_{10}, (particles are defined as having an average particle size of 10 microns in diameter (10 millionths of a metre), and have well documented respiratory effects on human health. These include effects on the respiratory and cardiovascular systems, asthma and mortality. PM_{10} particles are composed of primary combustion derived carbon-centred particles e.g. ultrafines, secondary particles from atmospheric chemistry eg ammonium nitrate, natural minerals e.g. soil, wind-blown, biological e.g. spores, bacteria and metals.

Studies have shown that most of the inflammation in the lungs could be explained by the mass of particle instilled, however, mass could not account for all of the variability in the data. It is believed the presence of metals such as iron, zinc, lead and nickel content of PM_{10} had the best association with inflammation out of all of the compositional measurements analysed. Primary particulate content of PM_{10} was also positively associated with inflammation.[2]

The Expert Panel on Air Quality Standards (EPAQS) concluded that particle air pollution episodes are responsible for causing excess deaths among those with pre-existing lung and heart disease. EPAQS also believe that any risk of lung cancer from the concentrations found in the streets of the UK is likely to be exceedingly small. However prolonged exposure for example 20 - 30 years to particles, which are likely to be combined with Polycyclic Aromatic Hydrocarbons (PAH) originating from unburnt or partially burnt fuel, is likely to be carcinogenic. (See Appendix 4)

There is a wide range of human activities that produce particle emissions, including; motor vehicles (mainly diesel), solid fuel burning, industrial processes, power stations, incinerators and construction activity. The main sources of anthropogenic (ie man made) particles in Jersey are from transport, the incinerator and domestic fuel burning. The oil fired power station in Jersey only runs for a few months a year and approx 97% of Jersey's energy comes from France via 2 under sea links.

Emissions from mainland Europe may make a significant contribution to secondary particles in Jersey. The UK Airborne Particles Expert Group's findings suggest that in a typical year with typical meteorology, about 15% of the UK's total annual average PM_{10} concentrations (about 50% of secondary particles) are derived from mainland Europe. In years of higher frequency of easterly winds, with large movements of air from mainland Europe, emissions in mainland Europe account for a considerably higher proportion of PM_{10} concentrations, particularly in south and east England. No work has been carried out to try and establish the contribution of secondary particles originating from Europe onto Jersey.

A UK government Air Quality Strategy Objective and a European Community Directive regulates concentrations of PM_{IO} in the UK (see section 6). The States of Jersey has agreed to work towards the limits set out in the European Daughter Directive 99/30/EC which deals with particles, sulphur dioxide, nitrogen dioxide, and lead. The main issues around air quality in Jersey relate to local air quality and the health impacts associated with high levels monitored mainly at road junctions and along canyon streets.

The BBC reports that the amount of solar energy reaching the Earth's surface has declined significantly between the 1950s and the 1990s, apparently due to particulate air pollution. Scientists are worried that this global dimming may be disrupting the pattern of the world's rainfall. Most alarmingly, it may have led us to greatly underestimate the greenhouse effect: with particulate pollution being brought under control, a global temperature rise of 10 degrees Celsius by 2100 could be on the cards, rendering many parts of the world uninhabitable. It is interesting to see the link between local air quality and global effects.[13]

http://news.bbc.co.uk/2/hi/science/nature/4171591.stm

3.0 Background

The Turnkey Osiris Particle Monitors (OSIRIS: Optical Scattering Instantaneous Respirable Dust Indication System) (see the photograph 1 below) were purchased in 1999 and 2002. They are designed to continuously monitor particle levels in particular Total suspended particles (TSPs), PM_{10} (Particles with an aerodynamic diameter of 10 microns) $PM_{2.5}$ and $PM_{1.0}$. The Osiris units sample particles as 15 minute averages.

Figure 1: The sampling sites in St Helier town centre

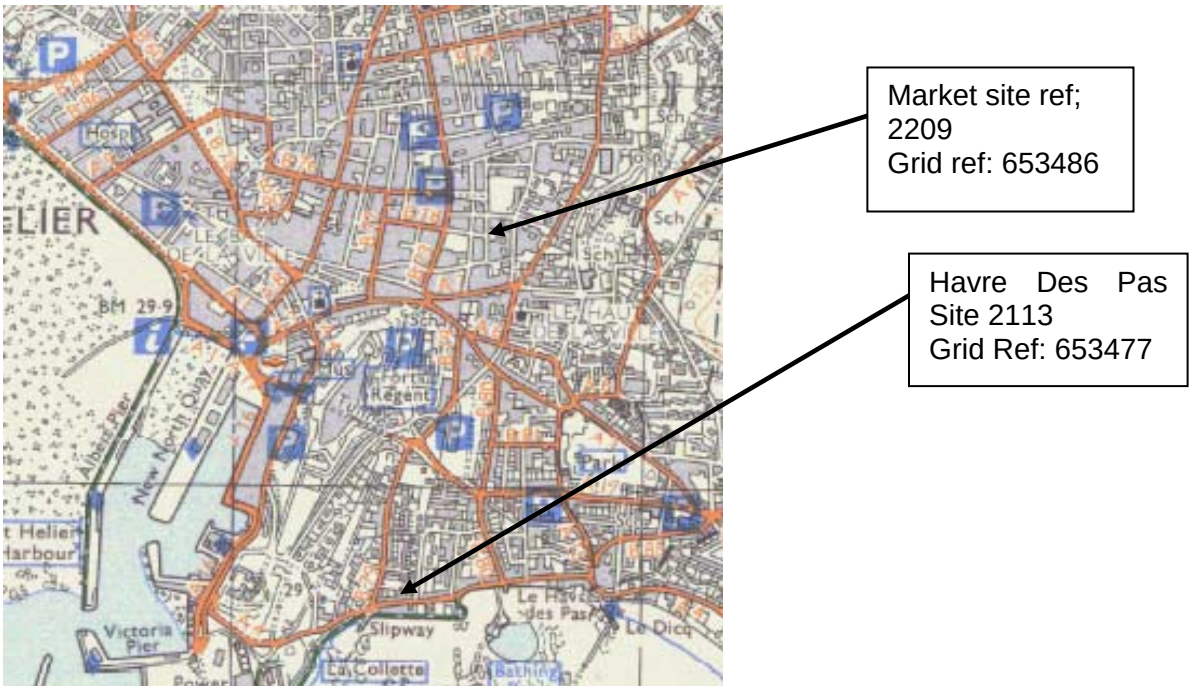


Figure 2: The Bellozanne sampling site

Photograph 1: The Osiris Unit

The Osiris units are served by a GSM modem which allows Officers from this Department to dial it up at any time and download the results using the Air Q 32 Software The data from both sites is now uploaded and emailed daily to the Jersey Meteorological Department and they are able to put it on to their website ie www.jerseymet.gov.je. (NB the web page is currently off line) This provides easier public access to the data.

The Osiris units are also fitted with a filter, which traps particles as they are sized and counted. The filter analysis allows the weight of particles to be determined and compared with the Osiris' computer calculated weight (ie to assess the accuracy of the Osiris). The analysis by TES Bretby of the filter also allows an indication of the sources of the particles and a percentage source contribution. The results are provided in section 5 and Appendix 6.

The unit at the central market was sited approximately 4 m above the pavement and approximately 3 m from Halkett Place. This road has up to 9 -10,000 vehicles per day with up to 1000 per hour at rush hour periods. The peak hours are around 8.00 am and 3 – 5 .00pm each day (see the photograph below). Previous work has shown the particle levels follow traffic numbers mix and speed closely. The site also is a busy area for pedestrians as there is the market and retail shops close by.

Photograph 4: The Position of the Osiris Unit at the central market Halkett Place St Helier

Osiris particle monitor at Jersey Market measuring traffic emissions on Halkett Place

On the February 2006 the unit ref; 2113 was moved from on top of a domestic garage on La Route de Nouaux, Bellozanne Valley to next to the Traffic and Transport workshops further up La Route de Nouaux to measure traffic emissions from vehicles using the valley eg driving to and from the incinerator, Jersey Coal, the Co-op warehouse. (See photograph 3 below)

Photograph 2: Position of Osiris Unit moved to Bellozanne Valley

Position of Osiris unit at Bellozanne valley site Grid Ref: 639501

The unit 2113 was moved from Bellozanne valley in September 2006 to Havre Des Pas sited on the de La Plage apartments. It is designed to measure particle levels associated with traffic driving to La Collette via Havre Des Pas to provide an indication of base levels for screening purposes. This information was designed to assist Traffic and Transport Services in providing screening data for the Health Impact Assessment in relation to the proposed Energy from Waste plant (efw) which is to be sited at La Collette.

Photograph 3: Position of the Osiris unit at Havre Des Pas

Position of Osiris unit at Havre Des Pas Site
Grid Ref: 653477

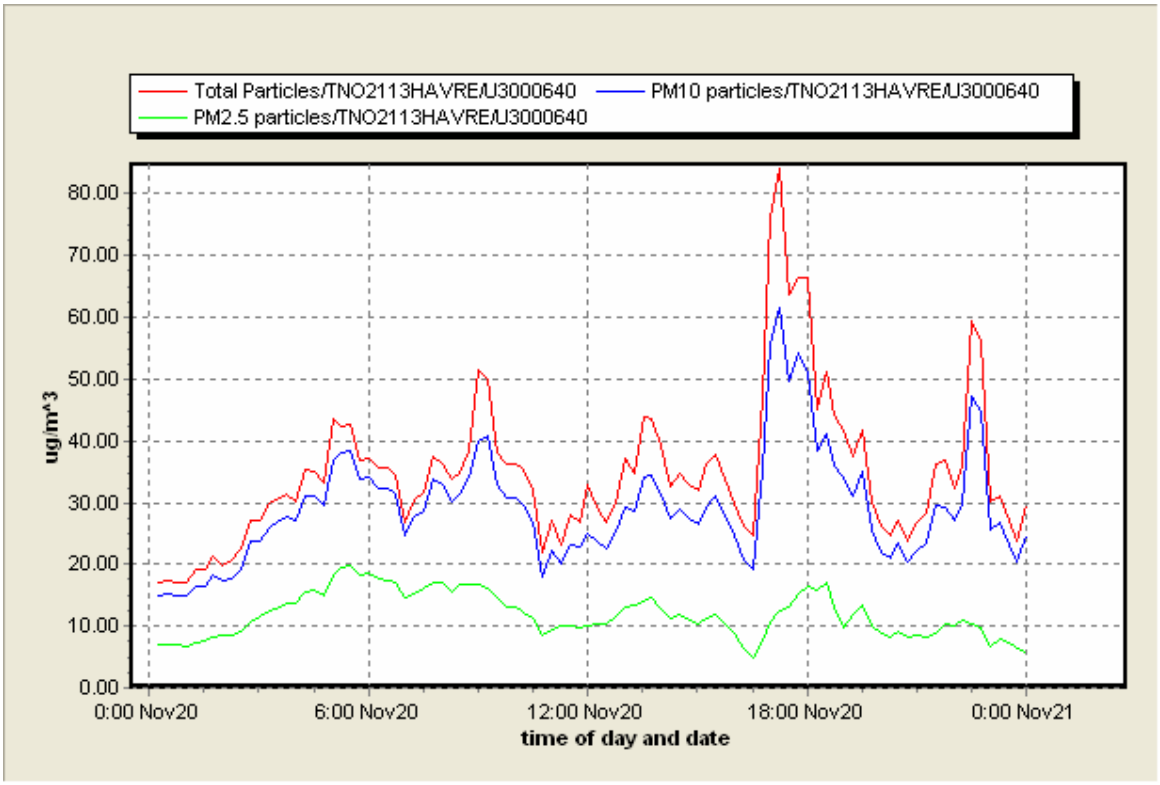
4.0 Results

The particle exceedances (ie PM_{10}) and air pollution results are presented below.

Results for 2006 for a 6 month period at the Market site exceeded the EC and UK Air Quality objectives by 3 times (8 corrected) and at Bellozanne valley site for a period of 2½ months 4 times (6 corrected). Results for a 3½ month period at the Havre Des Pas site exceeded the EC and UK Air Quality objectives 7 times (24 corrected). These objectives (ie Stage 2) only allow 7 exceedances per calendar year and should be complied with by 2010 in the UK.

Figure 1 below shows the particle levels over a 24 hour period for Monday 20th November 2006. Levels of particles increase up to 9.00 am, lunch time and particularly in the evening rush hour. There is often a vehicle or vehicles parked on Havre Des Pas which causes inevitable congestion. Particle levels follow traffic volume, mix and are influenced by speed ie congestion

Figure 1: Particle measurements at the Havre Des Pas Site on Monday 20th November 2006



The Turnkey Osiris Particle Monitor uses a heated inlet (50ºC) to evaporate water vapour particles which would result in inaccurate high readings, however it is believed that evaporation of volatiles/particles also occurs resulting in lower than normal results. Research has suggested that such results should be increased by up to 30% to increase their accuracy. However there are uncertainties as to whether 30% is the appropriate in all cases and areas of the UK. Details of the Osiris are provided in Appendix 2.

The relationship between meteorological conditions and particle levels is not clear. As wind speed increase particle levels reduce. The monitor at the Market site is in a canyon street which reduces dispersion/dilution of particles. As wind passes over the tops of the buildings eddying effects occur which cause circular dispersion. The Bellozanne site is a more open site with greater dilution and dispersion. The traffic using this road tends to move more freely and is less subject to congestion. The Havre Des Pas site is in a short canyon street and is likely to be affected by vehicles parking / stopping in this area as there are a number of guest houses and hotels with limited parking.

The European Union requires the use of a gravimetric (filter based) method to prove compliance, and the UK has suggested that its preferred Tapered element oscillating microbalance (TEOM) measuring devices are adequate if the results are multiplied by up to 1.3. It is this blanket nationwide uplift factor which may produce false exceedances. Although the Osiris is not as accurate as the TEOM it provides useful indicative results.

At the market site levels of particles spike early morning and this can explained by the presence of delivery/refuse vehicles close to the measurement site resulting in high levels of air pollution. The market have been asked to remind all delivery companies to switch off engines as far as is practicable whilst parked.

1. Air Pollution Bandings:	As a running 24 Hour mean	Market (corrected)	Bellozanne	Havre Des Pas
Low Air Pollution:	<50 µg/m^3	175 (170) days	72 (70)	101(84)
Moderate Air Pollution:	50 - 74 µg/m^3	3 (8)	2 (2)	7 24)
High Air Pollution:	75 - 99 µg/m^3	0	1(2)	0
Very High Air Pollution:	>= 100 µg/m^3	0	1(2)	0

[NB Those figures in brackets have been corrected /increased by 30 % to account for the loss of volatile particles caused by the heated inlet at the sampling head.]

According to the above bandings air pollution levels were generally low at the three sites but there were days of moderate pollution. 1 (2 corrected) day of high and very air pollution occurred at the Bellozanne site

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	Market (corrected)	Bellozanne	Havre Des Pas
2. 24 Hour daily mean: 50 µg/m3 not to be exceeded more than 35 times per calendar year by 2004 and 7 times per calendar year by 2010.	3 (8)	4 (6)	7 (24)

3. Calendar Year Annual Mean: 40 µg/m3 (Stage 2: 20 µg/m3)	21.34 (27.74) 178 days	16.78 (21.81) 76 days	31.59 (36.4)104 days

The tables above show that the PM_{10} particle results for all three sites exceeded the 24 Hour daily mean of 50 µg/m3 but not more than 35 times. The Market site results exceeded the stage 2 objective 3 times in 6 months (8 corrected). The Bellozanne site results exceeded the stage 2 objective 4 times (6 corrected) in 2½ months and the Havre Des Pas site results exceeded the stage 2 objective 7 times (24 corrected) in 3½ months. Stage 2 limits allow only 7 exceedances of 24 Hour daily mean 50µg/m3 per year however this limit is under review. The Havre Des Pas site exceeds the Stage 2 limit in a 3 ½ months period.

Although all the sites comply with the Stage 1 annual mean value of 40µg/m3 the market and Havre Des Pas sites fail the Stage 2 annual mean objective of 20µg/m3 **(Note: The annual mean results provide a guide as a full calendar year of results were not obtained**).

The results from the filters analysed by TES Bretby Ltd are summarised below. The examination procedure (ie Scanning Electron Microscopy and Energy Dispersive X Ray analysis) is based on the assessment of approximately 40 individual particles selected at random. The estimated percentage is based on a comparison of the relative number of particles counted in each category. (See Appendix 5 for the test reports and scanning electron micrographs).

The results are as follows:

a. Market site: Examination revealed that the collected deposit was mainly carbonaceous matter (28%) associated with vehicular emissions. Other materials present included: Sodium/Chlorine rich (12%) which indicates sea salt, Calcium/Aluminium/Silicon rich (15%), Plant animal fragments (23%), Potassium/Aluminium/Silicon rich(17%), Iron rich (5%) are classified as general dirt.

b. Various Sites including Bellozanne Valley: Examination revealed that the collected deposit included carbonaceous matter (17%) associated with vehicular emissions, Sodium/chlorine rich particles (10%) which indicate sea salt. Other materials present included: Aluminium/Silicon 15% Silicon rich (18% which indicates sand is present. Calcium/Aluminium/Silicon (5%) and Animal plant fragments (15%) Iron rich (2%) are classified as general dirt

Note: Care must be taken interpreting theses results as only a very small number of particles were analysed. Unfortunately the costs are prohibitive for greater in depth analysis.

5.0 EU and UK Guidelines

In Jersey the States have agreed to work towards the European Union Directive objectives. However in the UK, air quality standards and objectives for the major pollutants are described in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000 (The National Air Quality Strategy, or NAQS)[1]. An Addendum to NAQS was published in 2003, leading to some tighter air quality objectives.

The NAQS includes air quality objectives defined under European Directives, specifically the Air Quality Framework Directive (96/62/EC) and the four so-called Daughter Directives (1999/30/EC, 2000/69/EC, 2002/3/EC and 2004/107/EC), as well as objectives derived from work by the Expert Panel on Air Quality Standards (EPAQS).The NAQS makes a clear distinction between “standards” and “objectives”.

• *Standards* are the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive subgroups; and

• *Objectives* are policy targets generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedences, within a specified timescale.

Under the EC Air Quality Framework Directive (96/62/EC), all Member States have to assess their existing air quality and implement a programme of monitoring, dependent upon population, population density, emission sources and proximity of the general public to these sources.

Under the Framework Directive, a Member State MUST undertake continuous monitoring (using appropriate instrumentation) at least ONE site.

NETCEN recommend, therefore, that the island undertakes continuous monitoring for NO_2 and PM_{10}. For the first year at least, this was at the highest known pollution "hotspot" (Weighbridge). Once compliance with the Daughter Directive(s) is confirmed at this location, the site could be relocated to an area more representative of general population exposure (eg residential or urban background)

The EU Directive also details an: (24 hour limit value)

(a) **Upper Assessment threshold**: 60% of the limit value (30µg/m^3) not to be exceeded more than 7 times in any calendar year.

(b) **Lower Assessment threshold**: 40% of the limit value (20µg/m^3) not to be exceeded more than 7 times in any calendar year.

The upper and lower Assessment thresholds are presently being exceeded. Improvement in traffic management flow reduction will be needed to ensure the Upper Assessment threshold (UAT) is not exceeded in 2010.

Air quality should improve should occur in the next few years with better engine design Euro 4/5, relocation of the bus station to the Island site and further road changes as part of the St Helier Life program and Constable Crowcroft town centre improvements. The reviewed Air Quality Strategy and the TTS Sustainable Traffic and Transport Plan will also raise the profile of Air Pollution and measures to reduce it.

In the recent UK Government consultation on the air quality strategy, it was noted that the European Commission is developing a new Air Quality Directive and that the Commission has recognised that continuing to pursue the indicative 2010 limit values for particles is unlikely to generate a cost effective improvement in air quality. Therefore, it seems unlikely that the 2010 objectives will ever be included in legislation.

The EU and UK guidelines include:

1. Air Pollution Bandings:	As a running 24 Hour mean
Low Air Pollution:	<50 µg/m^3
Moderate Air Pollution:	50 - 74 µg/m^3
High Air Pollution:	75 - 99 µg/m^3
Very High Air Pollution:	>= 100 µg/m^3

2. 24 Hour daily mean: 50 µg/m3 not to be exceeded more than 35 times per calendar year by 31.12.2004 and 7 times per calendar year by 31.12. 2010. (NB Stage 2 Limits are under review)

3. Calendar Year Annual Mean: 40 µg/m3 (Stage 2: 20 µg/m3 to by achieved by 31.12.2010)

6.0 Improvements in particle levels in Jersey

PM_{10} concentrations in Jersey were generally higher than the UK comparison sites[5] but broadly similar to those found in London and Bristol. Levels at the Weighbridge and Market sites are broadly what could be expected at a roadside location in the UK.

Particle levels from other sources such as the power station have reduced with the use of the two cable links to France (ie up to the end of September 2003 97% of electricity used in Jersey originated from France).

The Easy link coach service began on the 19th April 2003. There are 10 - 15 buses operating with poor emissions compared to the cleaner Connex buses which have Euro 3 engines. When these engines are used in conjunction with low-sulphur diesel, emissions are very low. An aim should be to fit continuously regenerating particulate traps to Euro 2 and earlier diesel engines. (The cost is approx about £2 - 3,500 per vehicle, 90% of particles can be removed).

Other options are to move towards gaseous fuels such as the vehicles operated by Jersey Gas. The availability of bio-diesel in Jersey in the near future should lead to improvements. In London the trialling of water diesel emulsion is occurring which is claimed to halve particle emissions and cut NOx (i.e. Oxides of Nitrogen) by 23%.

Other improvements include:

(A) 2 new cremators which comply with the UK Environmental Protection Act 1990 Process Guidance notes

(B) A new waste to energy plant to be built in 2007/8 with improved emissions

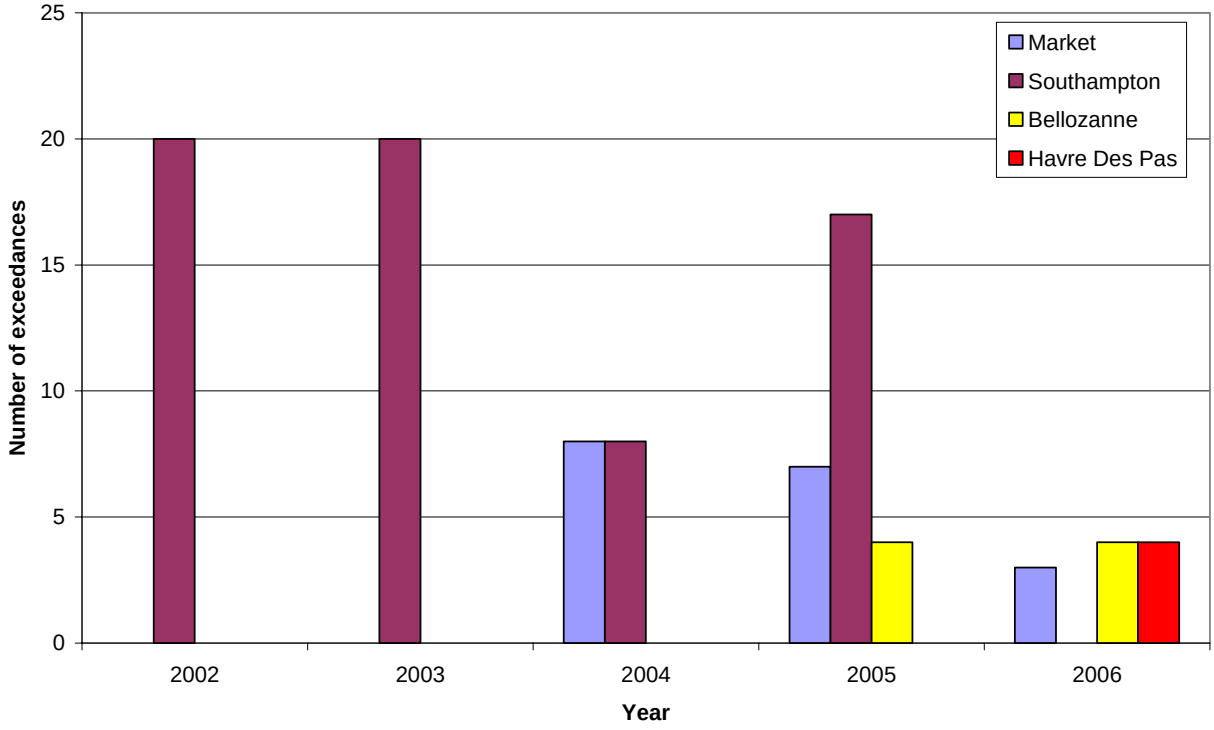
(C) New Building Byelaw Part L to improve insulation etc in domestic properties thereby reducing greenhouse gas emissions. Interestingly British Gas now offer a grant to improve the thermal insulation of domestic houses.

(D) Provision of further third electricity link to France reducing further the need to run the JEC oil fired power station.

(E) The growth in the usage of solar panels wind generators and heat pumps will reduce the reliance on other fossil fuels thereby reducing particle emissions from domestic premises.

Figure 2: Comparisons with the 2002 to 2006 data

Number of Exceedances at the Market, Southampton Hotel, Weighbridge and Havre Des Pas Sites from 2002 - 2006



The graph above shows that the number of uncorrected exceedances for the Southampton, Bellozanne and Havre Des Pas sites for 2006. These are lower than in previous years. Care needs to be taken in direct comparison as the measurement periods varied.

7.0 Conclusions

1.The Turnkey Osiris particulate monitors were set up at the central Market on Halkett Place, La Route es Nouaux, Bellozanne Valley, Havre Des Pas St Helier and used for a number of Short term monitoring surveys. The units measure particles in real time (ie Total Suspended Particles TSP, particles of a mean aerodynamic diameter of 10 microns PM_{10}, and particles of a mean aerodynamic diameter of 2.5 microns $PM_{2.5}$ and particles of a mean aerodynamic diameter of 1 micron $PM_{1.0}$ as 15 minute averages.

2. Particles are associated with a range of health effects. These include effects on the respiratory and cardiovascular systems, asthma and mortality. The Expert Panel on Air Quality Standards (EPAQS) concluded that particle air pollution episodes are responsible for causing excess deaths among those with pre-existing lung and heart disease. EPAQS also believe that any risk of lung cancer from the concentrations found in the streets of the UK is likely to be exceedingly small. However prolonged exposure for example 20 - 30 years to particles, which are likely to be combined with Polycyclic Aromatic Hydrocarbons (PAH) originating from unburnt or partially burnt fuel, is likely to be carcinogenic.

3. Results for 2006 for a 6 month period at the Market site exceeded the EC and UK Air Quality objectives by 3 times (8 corrected) and at Bellozanne valley site for a period of 2½ months 4 times (6 corrected). Results for a 3½ month period at the Havre Des Pas site exceeded the EC and UK Air Quality objectives 7 times (24 corrected). These objectives (ie Stage 2) only allow 7 exceedances per calendar year and should be complied with by 2010 in the UK. Although all the sites comply with the Stage 1 annual mean value of 40µg/m3 the market and Havre Des Pas sites fail the Stage 2 annual mean objective of 20µg/m3.

(Note: The annual mean results provide a guide as a full calendar year of results were not obtained). Care must be taken interpreting the results as the method of measurement is not an approved method as specified by the European Union and therefore the data provides a guide to whether the Health limits are being met or exceeded).

4. The relationship between meteorological conditions and particle levels is not clear. As wind speed increase particle levels reduce. The monitor at the Market site is in a canyon street which reduces dispersion/dilution of particles. As wind passes over the tops of the buildings eddying effects occur which cause circular dispersion. The Bellozanne site is a more open site with greater dilution and dispersion. The traffic using this road tends to move more freely and is less subject to congestion. The Havre Des Pas site is in a short canyon street and is likely to be affected by vehicles parking / stopping in this area as there are a number of guest houses and hotels with limited parking.

5 The Osiris has a glass fibre filter which collects particle material, which was further analysed to determine the sources of the particles and percentage contribution. Examination revealed in 2006 that the collected deposit was varied including sea salt, sand, general dirt and carbonaceous matter with particle size of <10 microns associated with vehicular emissions. Care must be taken interpreting these results as only a very small number of particles (40) were analysed. Unfortunately the costs are prohibitive for greater in depth analysis.

6. PM_{10} concentrations in Jersey were generally higher than the UK comparison sites[5] but broadly similar to those found in London and Bristol. Levels at the Havre Des Pas, Bellozanne and Market sites are broadly what could be expected at a roadside location in the UK.

9. Concentrations of all pollutants appear to be falling slightly with time. This is likely to be due to improved fuel composition and engine design[5]. However directive limits are becoming tighter and more health information is readily available.

10. Particle levels from other sources such as the power station have reduced with the use of the two cable links to France (ie up to the end of September 2003 97% of electricity used in Jersey originated from France).

11. The main issues around air quality in Jersey relate to local air quality and the health impacts associated with high levels monitored mainly at road junctions and along canyon streets.

12. Particles have been implicated in global dimming and highlight the relationship between local air quality and global warming.

13. Particle air pollution has improved when compared with previous years. Care is needed in drawing conclusions as there different measurement periods.

8.0 Recommendations

1. Further long term research (until at least 2010) should be carried out to assess levels of PM_{10}/$PM_{2.5}$ in Jersey compared to traffic numbers, mix and speed and meteorological conditions to establish trends and assess compliance with the European Union Daughter Directive objectives. This forms part of the integrated Air Quality Strategy. Further monitoring should involve the use of EU type approved measurement equipment to be meaningful and allow direct comparison with the UK.

2. Traffic data (eg volume, mix and speed) should be made available to allow more meaningful comparison with particle results.

3. Further work is needed to assess the relationships between meteorological data and particle levels.

4. A review of the Department's Air Quality Strategy is needed as soon as practicable. Raising the profile of air quality is needed.

5. Further research work could be carried to assess the contribution of secondary particles from mainland France to Jersey. Also analysis should be carried out to confirm that the 30% increase in figures associated with heated inlets is correct for this particular monitoring site.

6. An aim should be to fit continuously regenerating particulate traps to Euro 2 and earlier diesel engines. (The cost is approx about £2 - 3,500 per vehicle, 90% of particles can be removed). The provision of incentives to use LPG and biodiesel fuels is recommended. A reduction in Jersey’s Vehicle Registration duty (VRD) to promote the use of cleaner vehicles. Any environmental taxes introduced should be beneficial to promoting the use of cleaner vehicles.

7. The Department' needs to liaise with interested bodies and other Departments such as Planning and Environment and Traffic and Transport services to ensure Air Quality Objectives link into the Island Plan and Sustainable Tradffic and Transport Plan.

9.0. Appendix 1: The results compared to the UK/EU standards

Results for 2005		Sites		
1. Air Pollution Bandings: (days)	As a running 24 Hour mean	Market (corrected) days	Bellozanne	Havre Des Pas
Low Air Pollution:	<50 µg/m^3	175 (170)	72 (70)	101(84)
Moderate Air Pollution:	50 - 74 µg/m^3	3 (8)	2 (2)	7 (24)
High Air Pollution:	75 - 99 µg/m^3	0	1 (2)	0
Very High Air Pollution:	>= 100 µg/m^3	0	1 (2)	0
2. 24 Hour daily mean: 50 mg/m^3 not to be exceeded more than 35 times per calendar year by 2004 and 7 times per calendar year by 2010.		3 (175 days-8 corrected)	16.78 (21.81) 76 days	31.59 (36.4)104 days
3. Calendar Year Annual Mean: 40 mg/m^3		21.34 (27.74) 178 days	37.49 (48.73) 134 days	24.82 (32.26) 94 days
4. The EU Directive also details an: (24 hour limit value)				
Upper Assessment threshold: 60% of the limit value (30µg/m^3) not to be exceeded more than 7 times in any calendar year.		Yes	Yes	Yes
Lower Assessment threshold: 40% of the limit value (20 µg/m^3) not to be exceeded more than 7 times in any calendar year.		Yes	Yes	Yes

The upper and lower Assessment thresholds are presently being exceeded. Improvement in traffic management flow reduction will be needed to ensure the Upper and lower Assessment thresholds (UAT) are not exceeded in 2010.

10.0 Appendix 2: The Turnkey Osiris Particle Monitor

Osiris stands for *Optical Scattering Instantaneous Respirable Dust Indication System*.

The Osiris is an investigational instrument that fulfils the dual role of a portable instrument or permanent installation.

The instrument is housed in a sturdy die cast metal box with internal rechargeable battery. The external power source was connected for the long term monitoring. The internal memory was used to record PM_{10}, $PM_{2.5}$, $PM_{1.0}$ and Total Suspended Particles (TSP) as 15 minute averages for the monitoring periods. Each 24 hour period is saved in a folder for downloading to a computer and analysing with the Air Quality Programme for Windows. The Air Quality programme allows the data to be graphed and copied into Microsoft Excel for further analysis.

The instrument measures and records the concentration of airborne particles using a proprietary laser (nephelometer). An internal pump continuously draws an air sample through the nephelometer which analyses the light scattered by individual particles as they pass through a laser beam. These same particles are then collected on the reference filter. The nephelometer's dedicated microprocessor can analyse the individual particles even if there are millions of them per litre. This allows the size fractions to be determined at concentrations up to several milligrams/m^3.

The light scattered by the individual particles is converted into an electrical signal which is proportional to the size of the particle. A unique feature of the Turnkey nephelometer is that only light scattered through very narrow angles 10 degrees or less is measured. At this narrow angle the amount of light scattered is virtually the same for say black diesel or white limestone particles of the same size. That is, it doesn't depend on the material composition of the particle. On the other hand, the easier to measure right angle 90° scatter used by some earlier scattering instruments is highly dependant on material composition with white particles apparently scattering much more light than black ones of the same size.

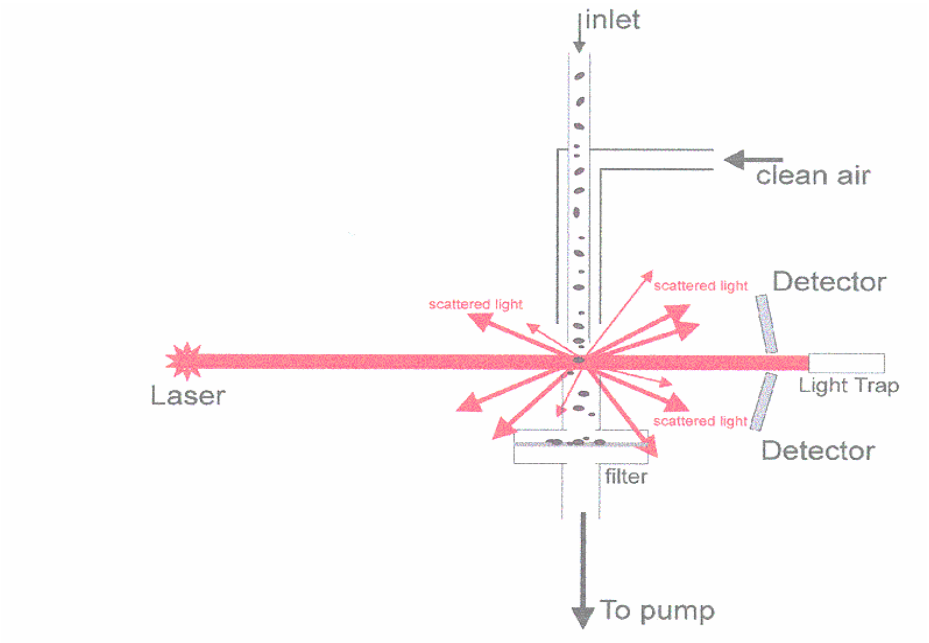
The light scattered by airborne particles can be thought of as consisting of three components. Light reflected from the surface of the particle, light refracted through the particle and light which is diffracted from its original path by the presence of the particle. The intensity of the light scattered by reflection or refraction strongly depends on the type of particle. Thus a white limestone particle will reflect much more light than a black diesel fume particle of the same size. On the other hand the diffracted component depends only on the size of the particle and is independent of its material composition.

For irregularly shaped particles, light, which is reflected and refracted, tends to be scattered over all possible directions. The diffracted component, however, tends to be scattered only through very small angles. For example, for a 5 micron diameter particle, 90% of the diffracted light is scattered by less than 10 degrees from the original direction of the light beam.(42)

The intensity of the light pulse is therefore an indicator of particle size, from this the microprocessor is able to calculate the expected mass of the particle. It assumes the material density of the particle is 1.5 grams per cc, which for most airborne dusts is a good approximation but the mass calibration factor can be adjusted to compensate for different material types.

Having evaluated the mass of the particle, the microprocessor then evaluates the likely chance of deposition of the particle according to the sampling convention being used (PM_{10}, thoracic, and so on) as shown in figure 19 below. Thus for the thoracic convention a 6 micron particle has an 80.5% chance of deposition, hence only this percentage of its evaluated mass is accumulated.(42)

Diagram of the Osiris particle monitor



11.0 Appendix 3: Relationship between the European transfer reference sampler and other PM10 sampling methods [9]

Monitoring of PM10 in the UK networks has, to date, been largely founded on the use of the TEOM analyser. A concern with the TEOM instrument is that the filter is held at a temperature of 50°C in order to minimise errors associated with the evaporation and condensation of water vapour. This can lead to a loss of the more volatile particles (such as ammonium nitrate etc).

The EU limit values and the UK objectives are based upon measurements carried out using the European transfer reference sampler, or equivalent. This is a gravimetric sampler, where the particulate material is collected onto a filter, and subsequently weighed. The filter is therefore held at fluctuating ambient conditions during the period of exposure. Whilst there will inevitably be some losses of volatile species from the filter (dependant upon the ambient temperature), these will be less than from the TEOM.

The Government and the Devolved Administrations have been investigating the relationship between the TEOM and the reference sampler, using co-located instruments at 6 sites in the UK. These studies have shown that the TEOM adjustment factor is site specific, and varies both from season to season, and from year to year. Because of this **an interim default adjustment factor of 1.3** has been proposed for the UK. This approach is supported by other studies carried out in other EU countries, and appears to also apply to ß-attenuation instruments with a heated manifold.

For the purpose of the next round of review and assessment, authorities should bear in mind the issues set out below:

• Measurements of PM10 concentrations carried out using the European transfer reference sampler, or equivalent, are directly comparable with the UK objectives and EU limit values, and no data correction is necessary. There are, however, important QA considerations to bear in mind, regarding the handling and weighing of filters.

• Measurements of PM10 concentrations carried out using a TEOM or ß-attenuation instrument, operating with a heated manifold, should be adjusted by multiplying the data by 1.3 to estimate gravimetric equivalent concentrations.

• Measurements of PM10 concentrations carried out using other sampling methods (e.g. optical analysers, or gravimetric samplers that have not been certified as ‘equivalent’) will need to be considered carefully, particularly if they are being used in a Detailed Assessment, and the concentrations measured are close to the objectives. Authorities with such analysers are advised to contact the relevant Helpdesk .

• It is not recommended that authorities carry out local intercomparison studies between the transfer reference sampler and other samplers for the purpose of review and assessment. Where such studies are carried out, it is **essential** to carry out the comparison over at least 6 months, including a summer and winter period. Any adjustment factors derived may be both season and site specific, and cannot simply be used to adjust data at other sites, in other years.

• The method of sampling is **critical** to the result. In all cases, authorities should explicitly state the method of sampling, and report all original and ‘adjusted’ data.

12.0 Appendix 4: Sources of particles

Box 8.1: Approximate contributions to PM_{10} concentrations (2002)

Type of particle	Source location	Main source categories	Main source types	Typical contribution to annual mean concentration ($\mu g/m^3$ gravi.)
Coarse 2.5-10µm	Immediate local (very close)	Traffic	resuspended dusts tyre wear	1 - 6
		Industry	fugitive dusts stockpiles quarries construction	variable, up to 5
	Urban background	Traffic	resuspended dusts tyre wear	1 - 2
		Industry	fugitive dusts stockpiles quarries construction	variable, up to 2
	Regional (including distant sources)	Natural	resuspended dust/soil sea salt biological	2 - 3 1 - 2 1
Fine <2.5µm	Immediate local (very close)	Traffic	vehicle exhaust	1 - 4
		Industry	combustion industrial processes	variable
		Domestic	coal combustion	variable
	Urban background	Traffic	vehicle exhaust	1 - 4
		Industry	combustion industrial processes	variable, up to 8
		Domestic	coal combustion	variable, up to 8
	Regional (including distant sources)	Secondary	power stations industrial processes vehicles	4 - 8
		Primary (Imported)	power stations vehiclesw industrial processes	1 - 2
		Natural	sea salt	<1

14.0 Appendix 5 TES Bretby Ltd test reports and scanning electron micrographs.

a. Central Market Site:

TES Bretby

TEST REPORT

UKAS TESTING 1205

OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Mr A M Irving Health Protection Public Health Services Le Bas Centre St Saviours Rd St Helier Jersey JE1 4HR	**Report Number**: **Job Number**: **Date Received**: **Date Analysed**: **Sample Description**: **TES Sample ID Number**: **Issue Date**: **Page**:	ED/AD/15973/SEM/0001, Rev. 0 ED/AD/15973 15 July 2006 25 July 2006 Glass Fibre filter (098198) – Market Roof Area ED/AD/0603495 31 July 2006 1 of 1

Identification of Dust Gauge / Environmental Deposits by SEM/EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Iron rich	5	Plant / Animal Fragments	23	Sodium / Chlorine Rich [$]	12
Calcium / Aluminium / Silicon Rich	15	Carbonaceous matter	28	Potassium./ Aluminium / Silicon Rich	17

[$] *This suggests sodium chloride (salt) is present.*
The other mineral particles may be classified as general dirt.

The examination procedure is based on an assessment of 40 individual particles selected at random.
The estimated percentage is based on a comparison of the relative number of particles counted in each category.

TES Bretby does not accept responsibility for the sampling associated with the results reported above.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

b. Bellozanne and other sites

TES Bretby

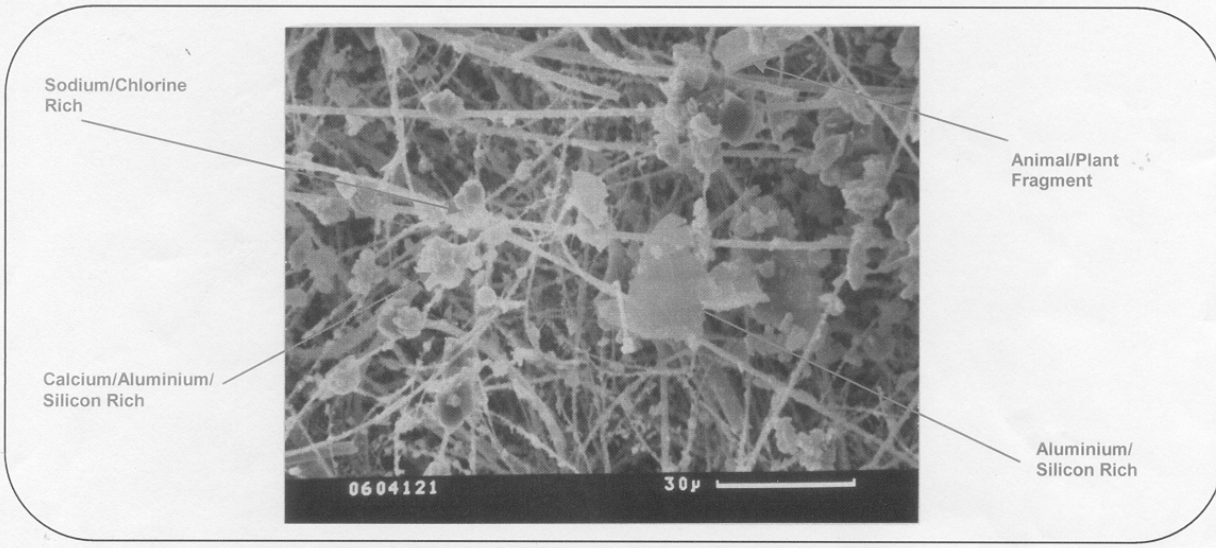
TEST REPORT

UKAS TESTING 1205

OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Mr J Fail	**Report Number**:	ED/AD/16080/SEM/0001, Rev. 0
Health Protection	**Job Number**:	ED/AD/16080
Public Health Services	**Date Received**:	16 August 2006
Le Bas Centre	**Date Analysed**:	24 August 2006
St Saviours Rd	**Sample Description**:	Glass Fibre filter (098199) – Various locations
St Helier	**TES Sample ID Number**:	ED/AD/0604121
Jersey	**Issue Date**:	25 August 2006
JE1 4HR	**Page**:	1 of 1



Identification of Dust Gauge / Environmental Deposits by SEM/EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Sodium/chlorine rich $	10	Aluminium/silicon	15	Carbonaceous matter	17
Animal/plant fragment	15	Silicon rich #	18	Iron rich	2
Potassium/Aluminium/ Silicon rich	18	Calcium/Aluminium/Silicon rich	5		

$ This suggests sodium chloride (salt) is present.
The other mineral particles may be classified as general dirt.
 # This suggests sand is present.

The examination procedure is based on an assessment of 40 individual particles selected at random.
The estimated percentage is based on a comparison of the relative number of particles counted in each category.
TES Bretby does not accept responsibility for the sampling associated with the results reported above.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

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